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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/677,545	10/02/2000	Schrens Martin	GR 99 P 4724	3079

7590 04/29/2003

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EXAMINER

NGUYEN, CUONG QUANG

ART UNIT PAPER NUMBER

2811

DATE MAILED: 04/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/677,545

Applicant(s)

MARTIN ET AL.

Examiner

Cuong Q Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 10-19 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-9, 20-22 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

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DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 20-22 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. There is no support for the limitation "an insulation layer disposed between said dielectric layer, said barrier layer, and said insulation collar" in the original specification or in the drawings. It is noted that, in present invention Fig.3B, an insulation layer (167') is formed on a top surface of the dielectric layer (164) and is not formed between the dielectric layer (164) and the insulation collar (168).

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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Claims 1, 3 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold (US 5,937,296) in view of Nishimura (US 4,949,138) and further in view of Economikos et al. (US 6,180,480).

Regarding claim 1, Arnold discloses a trench capacitor structure comprising: a substrate (12) having a trench formed therein, wherein the trench having an upper portion and a lower portion; an insulation collar (50, 58) formed in upper portion of the trench; a buried well (16) formed in the substrate, wherein the lower portion of the trench extending partly through the buried well; a capacitor dielectric layer (34, a silicon oxide or a silicon nitride layer) lining the lower and upper regions of the trench; and a conductive trench filling (32) formed in the trench. See Arnold's Fig.1.

Arnold does not teach that the capacitor dielectric layer (34) can be formed of tungsten oxide and the conductive trench filling formed of tungsten-containing material disposed in upper and lower regions of the trench.

Nishimura discloses a capacitor structure comprising a capacitor dielectric layer (15) is formed of silicon oxide, silicon nitride or tungsten oxide. See Nishimura's Fig.4 and col.2, lines 22-68.

Economikos et al. discloses a trench capacitor structure comprising a tungsten-containing material (30, 56) filled an upper region and a lower regions of a trench to form a storage node of the trench capacitor. See Economikos et al.'s Fig.6.

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It would have been obvious to one of ordinary skill in the art to form the capacitor dielectric layer of tungsten oxide instead of silicon nitride or silicon oxide as taught by Nishimura because these material are art recognized material for forming the capacitor dielectric layer and they are interchangeable. Moreover, one of ordinary skill in the art would have been motivated to do so because tungsten oxide has a very high dielectric constant comparing with silicon oxide or silicon nitride. It also would have been obvious to one of ordinary skill in the art to incorporate tungsten-containing filling material for forming the capacitor storage node as taught by Economikos et al. into Arnold's device in order to obtain a capacitor trench with completely filled conductive material. See Economikos et al.'s col.2, lines 23-30.

Regarding claim 3, the device formed by the combination of Arnold and Nishimura has capacitor dielectric layer of tungsten oxide which is the same material as claimed device. Therefore, the tungsten oxide capacitor dielectric layer in the device formed by the combination of Arnold and Nishimura inherently has a dielectric constant greater 50 as claimed.

Regarding claim 9, as shown in Arnold's Fig.9, a vertical transistor formed in the trench.

Claims 4-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Arnold in view of Nishimura, Economikos et al. and further in view of Wallace et al. (US 6,277,681).

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Arnold, Nishimura and Economikos et al. substantially teach all the limitations of claims 1, 3, and 9 as shown above but fails to teach that barrier layers formed between the capacitor dielectric layer and the capacitor electrodes.

Wallace et al. discloses a capacitor structure (col.1, lines 20-23) comprising silicon nitride barrier layer (13, 17) formed between the high dielectric constant layer (15) and conductive layers. See Wallace et al.'s Fig.2.

It would have been obvious to one of ordinary skill in the art to incorporate the barrier layers as taught by Wallace et al. into the device formed by the combination of Arnold, Nishimura and Economikos et al. in order to dopants in the conductive layers diffusing into the dielectric layer. See Wallace et al.'s col.3 lines 15-20.

Response to Arguments

3. Applicant's arguments with respect to claims 1, 3-9 have been considered but are not persuasive.

Applicants argue that Nishimura teaches that the capacitor is formed on the surface of semiconductor layer so it is a planar capacitor and not a trench capacitor; therefore one of ordinary skill in the art can not incorporate the material of capacitor dielectric into Arnold's trench capacitor. In response, it is noted that the difference between planar capacitor and trench capacitor is the arrangement in the semiconductor device and their functional characteristics are still the same, so material for forming the capacitor dielectric in a planar capacitor can be used in the trench capacitor.

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Applicants argue that none of references teaches that a conductive trench filling of tungsten-containing material disposed in the upper and lower regions of the trench and a dielectric layer of tungsten oxide material is lining lower and upper regions as claimed. In response, Economikos et al. teaches a tungsten-containing material (30, 56) filled upper and lower regions of the trench (Economikos et al.'s Fig.6), Arnold teaches the capacitor dielectric layer (34) formed on upper and lower regions of the trench, Nishimura teach the capacitor dielectric layer (15) is formed of silicon oxide, silicon nitride or tungsten oxide (Nishimura's Fig.4 and col.2, lines 22-68). So, as above discussed, the combination of Arnold, Nishimura and Economikos et al. teaches all the limitations of claims.

Conclusion

4. Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 and 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

5. Any inquiry concerning this communication or any earlier communication from the Examiner should be directed to CUONG Q NGUYEN whose telephone number is

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(703) 308-1293. The Examiner is in the Office generally between the hours of 6:30 AM to 5:00 PM (Eastern Standard Time) Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor TOM THOMAS who can be reached on (703) 308-2772. The fax phone number for the organization where this application or proceeding is assigned is (703) 308-7722 or 308-7724.

Any inquiry of a general nature or relating to the status of this application should be directed to the Technology Center Receptionists whose telephone number is 308-0956.



Cuong Nguyen

Primary examiner

April 22, 2003